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Development of Smart Physics Card as Physics Learning Media on Temperature and Heat Material

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Abstract. This study aims to develop media in the form of smart physics cards in temperature and heat parameters to determine the feasibility and attractiveness of smart physics cards. This research is a development research using ADDIE model. The stages are analysis, design, development, implementation, and evaluation. Researchers analyse the curriculum and analyse the used learning media. At the design stage, researchers design smart physics cards as needed. After being designed, the smart physics card media is validated by 4 validators. At the implementation stage, smart physics cards are tested by teachers and class XI students in odd semester 2018/2019. The last stage is the evaluation; the product is evaluated as a form of final evaluation of the results of the pilot test of teachers and students. The results show that the smart physics card is very feasible and very interesting because it has been through the validation and testing stages with a percentage of achievements of 90% according to material experts, 86% according to media experts and 85% according to physics teachers of SMA/MA grade XI. The results of trials on high school/MA students of class XI showed a percentage of achievements of 84.2% with very interesting criteria. From this development research, it was concluded that the smart physics card on the material's temperature and heat meets the requirements of a very decent quality and is very interesting to use as a learning medium for students of high school/MA grade XI.

Keywords: learning media, smart physics cards, temperature and heat material

1. Introduction

Education becomes very important to advance a nation [1]. Education will help us to gain insight and knowledge and skills obtained from teaching, training and research [2]. Education is done consciously in getting a learning process so that it makes itself more active in increasing the individual potential, including moral, spiritual, intelligence, personality and self-skills [3]. A successful learning goal, which has been planned and realized in schools, is inseparable from the availability of a complete school facilities and infrastructure. Among the facilities and infrastructure that must be available is the media [28]. The media becomes an intermediary for delivering messages or information in learning [5]. The use of media in learning is very important to support the learning process [6].

Based on pre-research data obtained from educators and students of class XI at SMA Negeri 1 Kedondong, MAN 1 Pesawaran, and MA Mathla'ul Anwar Kedondong, the results of the learning process carried out in the three schools were not as expected. After analysing, it is known that the learning media used by teachers not yet support the achievement of a learning goal, for example, the media used are quite boring and less interesting in increasing student learning interest, unlike game media. The teacher does not use smart physics cards.

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Interviews are also conducted with students. Many students think that physics material is quite difficult to understand and the media used in the learning process is less interesting. It causes the students feel lazy in learning. In addition, students are also lazy to do the exercises and homework given, if the homework is done, it is not from their own work but the students copy other students' work. This is due to students' lack of understanding and the atmosphere of learning in the classroom which is tense and causes students' bad behaviour and personality.

Based on these problems, an effort to overcome the students' learning problems in class is by using learning media. Learning media as a tool or intermediary in the learning process [7]; facilitates the teaching and learning process, so as to improve communication between educators and students to be more effective [6] and the media can be used as a tool in explaining either part or all of the learning material that is not yet understood [2]. Thus, the selection of appropriate learning media and adjustment to the material taught is needed due to the increased interest in learning is one indicator of good learning, and the achievement of learning objectives.

Physics learning is the process of studying nature and its events, which are related to understanding concepts, theories, laws, principles and the ability to carry out processes: measurement, experimentation, reasoning and problems in science. Therefore, in understanding and studying Physics it is not enough to learn through books and explanations from the teacher, but also media is needed to facilitate understanding of Physics material, including using media games in the learning process [8].

Game is still seen as a medium of entertainment rather than a medium of learning [9]. The nature of a game is challenging, it makes people happy, and it will have a bad effect if the game is less educational. Therefore, it is necessary to develop educational games [10, 11]; which can be used as a learning medium in order to increase interest [12]; and stimulate the power of thought patterns [13]; students will be more concentrated in learning [14].

From an educational point of view, the game promotes and enhances students' involvement in design, dynamic and inclusive. A game's informality also encourages involvement because students first play and then learn as a consequence of playing. This has proven productive in promoting meaningful learning [15].

Many studies have revealed that students are positive about the use of educational games in learning and they usually describe educational games as motivating [16] and helping to understand complex subjects. Learning by utilizing media in the form of games can also encourage students to be more active in learning and able to increase their knowledge [8]. From the perspective of students, they might want to have something fun that allows them to play and learn at the same time. However, the teacher can see it from a different perspective.

In this case, researchers are very interested in conducting research on game media in the form of smart cards that are used in the learning process. A smart card is a tool that contains theories, pictures, and concepts related to the theme of the material being studied. Smart cards have three types of cards namely, short cards, picture cards and index cards. These cards have pairs which must be matched while in use or playing. Thus, this smart card is used as a media for games in the learning process [17]. Efforts are made to overcome the problems above is by developing learning media in the form of games of smart physics cards as an alternative in learning, then to find out the feasibility and attractiveness of the media so as to facilitate students in understanding the temperature and heat material in learning physics.

2. Research Methodology

The research method used is the research and development method. In this study, learning media will be developed in the form of smart physis cards in the temperature and heat material in class XI SMA / MA. The smart physics card development model used is the ADDIE model, where the development model consists of five stages, namely analysis, design development, implementation, and evaluation [18, 19]. The stages of developing smart physics cards based on the ADDIE model are shown in Figure 1

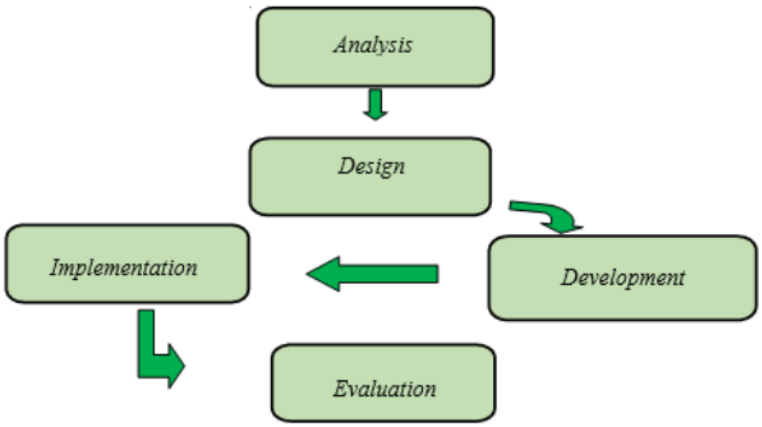


Figure 1. The stages of using research and development (R&D) methods ADDIE model.

The instrument used in this study was a non-test instrument in the form of a material expert validation sheet, a media expert validation, a physics questionnaire response sheet for class XI students and a questionnaire sheet for class XI students. The results obtained have been revised and used as material for consideration in improving smart physics cards. Analysis of non-test instrument data in this study uses descriptive data analysis techniques - Non-test instruments in the form of a questionnaire using a Likert scale. Likert scale is used to measure the opinions, perceptions and attitudes of a person or group about a social phenomenon [20]. This study used a scale of 1 to 5, with the lowest score of 1 and the highest score of 5.

3. Result and Discussion

The process of developing a Physics learning media in the form of a smart physics card game begins with the analysis stage, wherein the process of observation and interviews with educators and students is carried out. This preliminary research includes observation activities during the teaching and learning process, the use of instructional media, interviews with physics teachers, the state of the school regarding student characteristics, learning processes, school curriculum, reviewing literature (existing products), and identifying the factors that cause problems so there needs to be a new development model through the process of observation and interview. Based on observations and analysis at MAN 1 Pesawaran, SMA 1 Kedondong and MA Mathla'ul Anwar, it requires an innovative learning media that can train students to think creatively, critically and create a pleasant atmosphere in learning. A media in the form of a smart physics card game is to encourage students to learn Physics.

The first stage is designing [15]; or making a draft of the learning media product in the form of a smart physics card game. In this stage, relevant sources of learning material from several textbooks such as Serway, high school textbooks, and internet are needed. After all the material has been collected, indicators and contents of the Smart Physics Card are made up of Smart Information, questions and keywords in Microsoft Word. After the Smart Physics Card meets all the indicators, the Smart Physics Card design in CorelDraw X5 is created. It also made the design of card material and card problems and game rules. After the design is finished, then it is printed and to form a card.

After the first stage is completed, the finished product is validated by material experts and media experts. At first, the truth of the presentation of concepts in terms of material was still not quite right. In

terms of the contextuality of the material presented, it is recommended to use pictures that are appropriate to the material. In addition, there are some sentence formulations that are considered ineffective so that it needs to be improved in terms of material, there are also materials that are not in accordance with the indicators and the lack of assessment results sheets in the game. While in terms of media, there are still images and writing on the card that is not clear. Color selection used is less contrast, and the size of the card should be enlarged and thickened. The rules of the game are still in the form of coherent sentences so that they are difficult to understand. Media experts suggest that charts or flowcharts should be made. And there is no box for storing smart physics cards. From the results of the evaluation by experts, revisions are then carried out according to the experts' recommendations in order to meet the criteria well or properly used as a learning medium. After the revision, the media was consulted again by experts until it was declared eligible for a trial. After being declared valid or feasible, the media are tested on a small group of 2-3 groups to find out the students' response to the media and to analyze the obstacles that might be encountered during implementation in the classroom.

After finishing playing the Smart physics card game, students give an assessment of the media. In general, students are able to accept the media well so that there are no suggestions for improvement in the media from students. When testing a small group, the teacher also assesses the material aspects and aspects of the media to provide comments and suggestions so that the media becomes better. The teacher suggests that the media should be used to review the lessons. Then, the implementation is done when students have received material about temperature and heat. In addition, the teacher provides suggestions for students to record questions and answers while playing so that the material recorded has been obtained. From the results of the teacher's evaluation, there was a slight improvement in the rules of the game, namely the addition so that students prepare a piece of paper to record questions and keywords.

At this stage, a field test or implementation of the smart physics card media is conducted in the XI MAN 1 Pesawaran class, SMA Negeri 1 Kedondong and MA Math'laul Anwar. Based on the assessment in the field test, students generally received the media very well, although there were still a number of statements that the students felt strongly disagreed with. In this stage, students only provide comments but do not provide suggestions for improvement in the media so that the media of smart physics card is not revised again.

The last stage is the Evaluation stage. At this stage, what was evaluated included in a needs analysis, media design, preparation of learning tools, product trials and their application. In evaluating the media that has been developed, an interview process is conducted between the teacher and students. There are three main criteria in evaluating media, namely the quality of content and objectives, instructional quality and technical quality. To find out the quality, an analysis of the results of the interviews and assessments of the questionnaires is needed.

The feasibility of instructional media in the form of smart physics card games is obtained from data that has been obtained from the assessment of material experts, media experts, and teachers. The instrument used by using an assessment or score 1-4 in accordance with the predetermined percentage of the result score is $0\% \leq P \leq 25\%$ means very bad / worthy, $25\% < P \leq 50\%$ means not good / feasible, $50\% < P \leq 75\%$ means good / decent, $75\% < P \leq 100\%$ means very good / decent. Based on the results of the feasibility assessment from the experts can be seen in Table 1.

Table 1. Media assessment of smart physics cards by experts

No	Assessment	Final score precentage	Criteria
1	Material Expert	90%	Very decent
2	Media Expert	86%	Very decent
3	Teacher	85%	Very decent

Scores of the assessment results by the three experts included in the interval with Very Eligible criteria so that it can be stated that the smart physics card game meets the criteria very well / is worthy of being used as a Physics learning media.

The attractiveness of the Smart Physics media is obtained from the data that has been obtained from student assessments. The instrument used with the rating or score 1-4 corresponds to a predetermined percentage interval of the result score is $0\% \leq P \leq 25\%$ means very unattractive, $25\% < P \leq 50\%$ means unattractive, $50\% < P \leq 75\%$ means interesting, $75\% < P \leq 100\%$ means very attractive. The results of the assessment of attractiveness from students can be seen in Table 2.

Table 2. Media Assessment of students' Smart physics cards

No	Assessment	Final Percentage	Criteria
1	Small trial	85%	Very interesting
2	Field trials	84,2%	Very interesting

Smart physics card media assessment on 30 students, 10 students from SMA Negeri 1 Kedondong, 10 students from MAN 1 Pesawaran, and 10 students from MA Mathla'ul Anwar get the results with a percentage of attractiveness of 85% with very interesting criteria in all measured aspects, namely the appearance of the media, the media material, then the ease of use, linguistic and conformity of concepts and implementation.

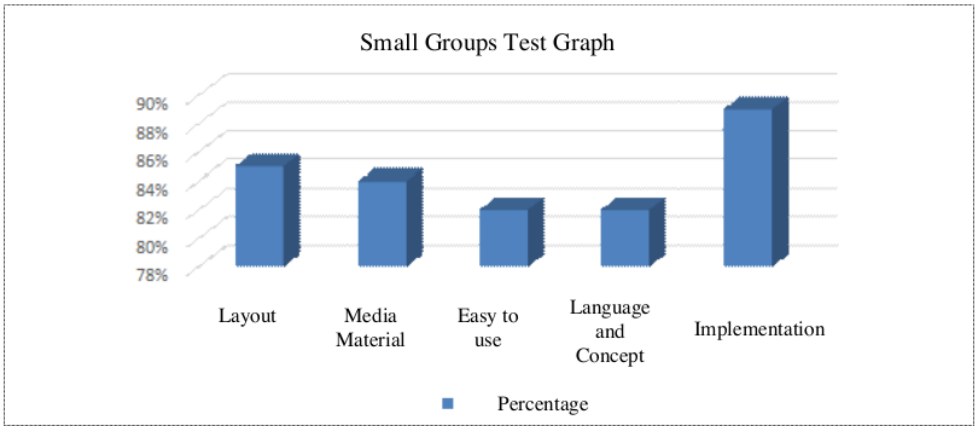


Figure 2. Small Groups Test of Class XI Students

Furthermore, the results of the field trials of 70 students namely 20 SMA 1 Kedondong, 25 students from MAN 1 Pesawaran, and 25 students from MA Mathla'ul Anwar Kedondong get the results with a percentage of attractiveness of 84.2% with very interesting criteria in all measured aspects , i.e. appearance of media, media material, then ease of use, language and conceptual suitability, and feasibility.

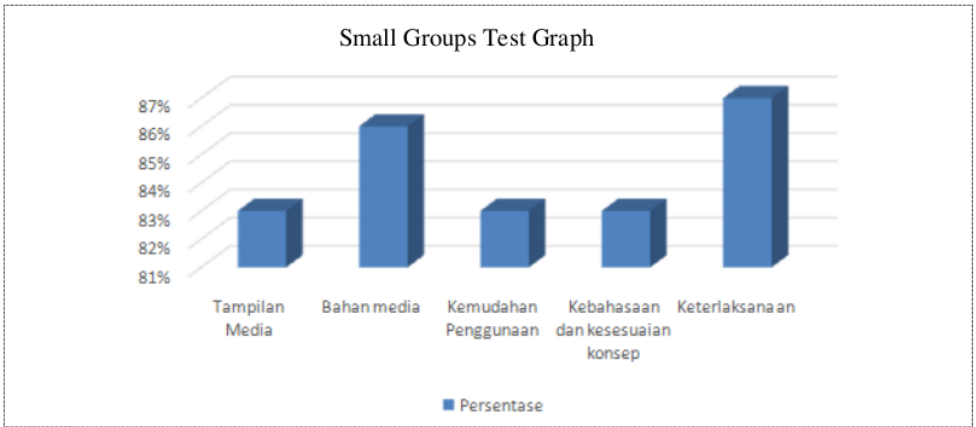
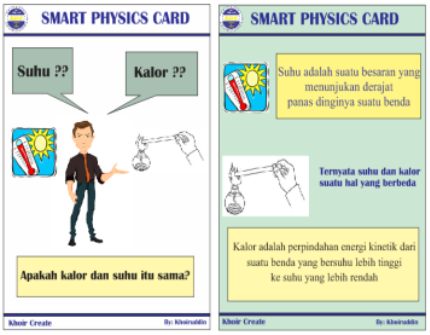
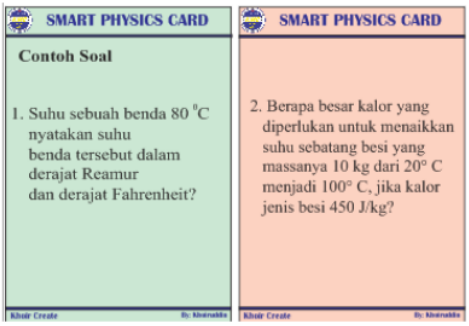


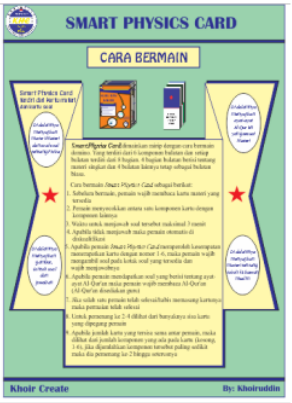
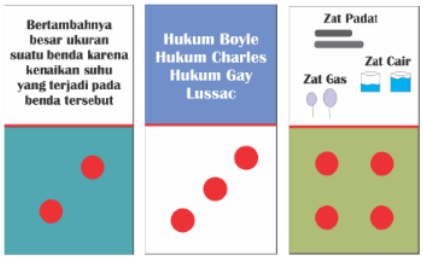
Figure 3. Class XI Field Test for Students

The final product in this research development is a set of learning media in the form of smart physics cards consisting of 1 set of material cards and questions and 1 set of dominoes and instructions for using the smart physics card. 1 set of material cards and questions consists of 31 cards containing material and temperature and heat problems and 1 set of domino cards consisting of 28 cards. The following are some tips from the smart physics card after being validated by the experts and after being tested by an expert review trial, a small group trial and a field trial.

Table 3. Final Display of Smart physics card After Revision Validation and Trial

No	Display *Smart physics card*	Information
1		Front cover page display (smart physics card box)

2		Display several smart physics card material
4		Display of sample card problems on the smart physics card
5		Display cards of verses of the Qur'an related to Temperature and Heat Material

6		Display of cards on how to play smart physics cards
7		Display of several smart physics card games

Smart physics card is a modification of rummy and domino games. A distinctive feature that distinguishes smart physics cards from playing cards and dominoes is that there are pieces of temperature and heat material combined with red circles 1-6 inside the domino. There is another characteristic of smart physics card that distinguishes it from other games, which is having a mission so that the opponent / other players can answer the question correctly, the player gives the other players the opportunity to go right counter clockwise if unable to answer it. Smart physics card assessment scores are able to assess 3 aspects of learning outcomes, namely cognitive, affective and psychomotor aspects. Based on the research that has been done, it suggested the following things: 1) Smart physics card learning media is not only used for students in class XI, but must also be used for class X, and XII as additional reference material for knowledge in understanding physics materials, 2) we need to develop a more complete smart physics card and have a more attractive design, 3) we need to continue the development distribute the product (dissemination).

Conclusion

Based on the results of the development and research results by material experts, media experts on teacher trials, small group tests and field tests to high school / MA grade XI students, it can be concluded that the smart physics card meets the requirements of a very decent quality and very interesting to use as an alternative learning media for high school / MA students.

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